

DRAFT

REPORT OF THE AGRICULTURE WORKING GROUP

to the

NATIONAL DROUGHT POLICY COMMISSION

11 June, 1999

Washington, DC

REPORT OF THE AGRICULTURE WORKING GROUP to the NATIONAL DROUGHT POLICY COMMISSION

Table of Contents

- I. [Introduction](#)
- II. [Executive Summary](#)
- III. [Background Information and Current Federal Drought-Related Information](#)

SELECTED REFERENCES ON DROUGHT

APPENDIX A. List of Acronyms Used in This Report

APPENDIX B. List of Federal Members of the Agriculture Working Group

APPENDIX C. Summary of Recommended Federal Actions from Earlier Drought Episode Reports

I. Introduction

00 June, 1999

To the Members of the National Drought Policy Commission:

This is the draft Report of the Agriculture Working Group. We have attempted, in the short time available to us, to gather as much information as possible on existing laws, programs, etc., primarily at the Federal level. This report also focuses on needs and gaps, but it is by no means an exhaustive list.

We know there is much more information to be added -- from the State, local, and tribal levels -- and that the Commission will uncover much of this in the next few months. However, we hope that this will provide a sound basis for the additional work that will be done by all of us to complete the charge that Congress has given the Commission.

WARREN LEE
Co-Chair
Agriculture Working group

PATRICIA GARAMENDI
Co-Chair
Agriculture Working Group

II. Executive Summary

Concerns about drought underlie the creation of the National Drought Policy Commission (NPDC) by the US Congress. The sections of this report are a first compilation of mainly Federal efforts to deal with drought emergencies for members of the National Drought Policy Commission, newly-constituted under the National Drought Policy Act of 1998 (PL 105-199). It is hoped that this report will form part of the basis of the Commission's final report to Congress.

Much of this draft report has been structured around the eight critical questions asked by the legislation. A summary of initial needs identified follows.

Preparedness

- Improve the accuracy of short and long range weather forecasting.
- Monitor plant stress and soil moisture status more completely.
- Develop a national framework that integrates actions and responsibilities among all levels of government that clearly spells out preparedness, mitigation and response measures to be provided by each entity.
- Develop drought contingency plans at each level of government that includes early detection, monitoring, decision-making criteria, short and long range planning, and mitigation.
- Develop public awareness and education campaigns on drought and water conservation measures.
- Consolidate meteorological, agronomic, and hydrological data to produce an index(s) that can be used in decision making and allocation of available funds.

Mitigation

- Programs and policies that provide greater opportunity and incentives to proactively integrate drought planning into day-to-day business decisions thereby reducing the effects of drought and reducing the overall response and recovery costs.
- Incentives for drought mitigation and planning at the local, state and regional levels including educational resources that promote the concepts of drought planning.
- Expanded drought insurance coverage for additional crops
- Train farmers to be more active risk managers.
- Assess if drought mitigation criteria can be incorporated into existing disaster assistance programs.
- Additional research on:
 - Developing new germplasm resistant or tolerant to drought
 - Developing management strategies that effectively exploit available water, increase available water and match new germplasm.

Response and Recovery

- Establish a more permanent funding source for response and recovery programs.
- Establish a common "trigger" for activating the Emergency Loans, Noninsured Crop Disaster Assistance Program, livestock assistance, tree assistance and dairy assistance programs.
- Change statutory language that requires the producer to choose between benefits available under multiple disaster programs.
- Expand authorities for the Emergency Watershed Program (EWP), Emergency Conservation Program (ECP) and the Tree Assistance Program (TAP).
- Develop a data base of program costs associated with drought and other weather related disasters.

III. Background Information and Current Federal Drought-Related Information

Concerns about drought underlie the creation of the National Drought Policy Commission (NPDC) by the US Congress. The following sections of this report are a first compilation of mainly Federal efforts to deal with drought emergencies for members of the National Drought Policy Commission, newly-constituted under the National Drought Policy Act of 1998 (PL 105-199). It is hoped that this report will form part of the basis of the Commission's final report to Congress. Much of this draft report has been structured around eight critical questions asked by the legislation.

In general, the NPDC's five working groups have been assigned the task of compiling and reviewing laws and programs at all levels of government so that recommendations can be made to plan mitigation as well as improvements in response. The eight issues being addressed by the working groups are typical of risk management issues for which risk assessment can form a framework for organizing complex information.

Drought in the United States

Drought is a reoccurring feature of the American landscape. Although the United States (US) is considered a water-rich country by the international community, about 40% of the US is considered arid, semi-arid, or dry sub-humid. These lands comprise almost half of the continental US west of the 100th meridian, encompassing 17 western states. Drought can occur almost anywhere in the US, and the agriculture and forestry sector is particularly vulnerable to the effects of drought and other weather-related phenomena. There is significant variation in water availability from one place to another and from one year to the next.

Today, government relief for farmers, ranchers, and other landowners affected by drought takes many forms. However, drought relief was not seen as a Federal responsibility until early in the 20th century. The Federal government made its first drought disaster loans to farmers during the wartime emergency in 1918. The first extensive programs for drought relief came during the "Dust Bowl" days of the early 1930s. The Federal government also conducted research and transferred soil and water conservation technologies to landowners to stabilize the soils of the semi-arid Great Plains.

Laws, programs, and agencies have been created by Federal, State, local, and tribal governments in response to droughts that have cyclically occurred throughout the 20th century. The actions supported by these laws and agencies are predicated on concerns that droughts cause unwanted impacts, that they are highly likely to recur, and that their effects on American society can be severe.

III.1

Section 4(b)(1). “determine, in consultation with the National Drought Mitigation Center in Lincoln, Nebraska, and other appropriate entities, what needs exist on the Federal, State, local, and tribal levels to prepare for and respond to drought emergencies.”

A summary of initial needs identified follows.

Preparedness

- Improve the accuracy of short and long range weather forecasting.
- Monitor plant stress and soil moisture status more completely.
- Develop a national framework that integrates actions and responsibilities among all levels of government that clearly spells out preparedness, mitigation and response measures to be provided by each entity.
- Develop drought contingency plans at each level of government that includes early detection, monitoring, decision-making criteria, short and long range planning, and mitigation.
- Develop public awareness and education campaigns on drought and water conservation measures.
- Consolidate meteorological, agronomic, and hydrological data to produce an index(s) that can be used in decision making and allocation of available funds.

Mitigation

- Programs and policies that provide greater opportunity and incentives to proactively integrate drought planning into day-to-day business decisions thereby reducing the effects of drought and reducing the overall response and recovery costs.
- Incentives for drought mitigation and planning at the local, state and regional levels including educational resources that promote the concepts of drought planning.
- Expanded drought insurance coverage for additional crops
- Train farmers to be more active risk managers.
- Assess if drought mitigation criteria can be incorporated into existing disaster assistance programs.
- Additional research on:
 - Developing new germplasm resistant or tolerant to drought
 - Developing management strategies that effectively exploit available water, increase available water and match new germplasm.

Response and Recovery

- Establish a more permanent funding source for response and recovery programs.
- Establish a common "trigger" for activating the Emergency Loans, Noninsured Crop Disaster Assistance Program, livestock assistance, tree assistance and dairy assistance programs.
- Change statutory language that requires the producer to choose between benefits available under multiple disaster programs.
- Expand authorities for the Emergency Watershed Program (EWP), Emergency Conservation Program (ECP) and the Tree Assistance Program (TAP).
- Develop a data base of program costs associated with drought and other weather related disasters.

Federal level Needs:

Department of Agriculture:

Recently, USDA's Economic Research Service (ERS) published a report, "Managing Risk in Agriculture." To find this report, search on the Internet under [http:// www.econ.ag.gov](http://www.econ.ag.gov). The main conclusions from the USDA-ERS recent risk report, which focuses on the farm-level income risks associated with natural disasters (such as drought), include:

The economic impacts of droughts and other natural disasters can be quite different depending on the supply and demand characteristics for different commodities. For major field crops grown in a wide variety of geographic areas, (for instance wheat), severe drought in specific locations (and hence, low supplies) on increasing prices (as well as price variability) tends to be less than for crops that are produced in narrower geographic areas and that have fewer substitutes (such as lettuce or apples).

In addition to government programs, farmers have many alternative strategies that they can use to manage the risks associated with droughts and other natural disasters. These include diversification, both across different geographic areas and across different types of commodities. A farmer who has both livestock and several crops is less likely to be severely affected by drought, for example, than a farmer who works with a single crop. Also, farmers can use various types of contracting, can hedge in futures markets, etc., to reduce the price risks associated with natural disasters. Cultural practices (such as irrigation and planting varieties with different maturity dates), can help mitigate the income risks associated with drought, and Federal-level programs--such as crop insurance and NAP--are also important.

USDA's Agricultural Resource Management Study (ARMS) is a comprehensive annual survey that recently asked questions regarding risk management. The highest percentage of farms indicated that they would draw upon cash on hand to help mitigate the risks associated with droughts and other natural disasters. Producers in the smallest sales classes (<\$50,000) are much less likely to use different tools and strategies (contracting, hedging, diversification) than are larger-scale farmers. This situation has implications for educating producers as to ways to mitigate the income-risk effects of drought--especially smaller-scale farmers. (It's also important to keep in mind that these small-scale farmers are also more likely to rely on off-farm income to a much larger extent than larger farms--which can also help reduce income risk in the face of disasters.)

The income risks associated with droughts and other natural disasters tend to be less in the major growing areas than in peripheral areas of production. In major growing areas (such as the Corn Belt for corn), low yields tend to be highly correlated with high prices, and vice versa. This relationship works as a *natural hedge* that helps stabilize income (calculated as price * yield) risk. In addition, major producing areas inherently tend to have lower yield risk. Thus, the *peripheral* producing areas tend to have higher inherent income risk, compounded by both higher yield variability and a weaker *natural hedge.* These areas are more likely to be adversely affected by drought, and to realize the greatest impact on farm-level income risk.

Bankers and other lenders are well aware of the risks of drought and the impacts on farm incomes. In risky situations, lenders use various strategies to protect their interests. Lenders in higher-risk areas may charge higher interest rates, be quicker to limit loan amounts, charge special fees, etc. Situations in which government programs are known in advance regarding payouts in drought situations (e.g., crop insurance) are more likely to be more favorably viewed by lenders (and result in more favorable terms to farmers) than those that are ex post and are uncertain as to their implementation.

Research indicates that younger producers are more likely to participate in risk mgt. programs than are older farmers. In addition, participation tends to be positively associated with education, the percent of crop acres on the farm, total farm acres, and the degree of farm leverage.

Needless to say, extended droughts can have a major impact on rural communities. When producers have less money to spend in heavily agricultural-dependent areas, local businesses realize severe impacts in addition to the farmers themselves. This can have implications for not only businesses, but schools and other rural institutions.

Other Needs Identified by Federal-level Contributors:

- A federal interagency commission or council should be established for drought coordination with states and regional agencies. This group should determine the federal government's role in drought response and mitigation. They should also seek to focus federal response and information so that states and local governments have access to "one-stop shopping."
- Of family farmers suffering from the effects of drought, only those who are raising traditional row crops meet all eligibility requirements for the existing FSA EM Farm Loan Program. The current FSA EM Farm Loan Program excludes livestock ranchers from qualifying for loans under drought conditions. These ranchers experience pasture grazing and hay production losses during dry conditions. Prudent ranchers increase culling of their basic herd to compensate for decreasing forage availability which results in less calves carried to market and a loss on the sales from culled cows due to over supply. Most area ranchers will not have sufficient grazing and are forced to increase culling thereby flooding the local markets.
- "Future policies should provide greater opportunity and incentives to proactively integrate drought planning into day-to-day business decisions thereby reducing the effects of drought and reducing the overall response needs to all sectors including: agriculture, water allocation and planning, wildlife and environment".¹
- "Water conservation measures should not be mandated or applied universally in the absence of specific goals. Rather, water conservation is best viewed as a complement to, not as a substitute for, more traditional water supply development. The objective is the same--to satisfy the needs of water users in the most cost-effective and efficient manner without adversely impacting public health, safety, or the quality of life and the environment".²
- "The NDPC should provide specific ideas which Congress could consider in national legislation to encourage the incorporation of incentives for drought mitigation and preparedness at the local, state and regional levels including educational resources that promote the concepts of drought planning".¹
- Drought coverage could be expanded or modified under the existing statutory authorization as long as the risks associated with the modifications were adequately rated for the purpose of maintaining actuarial soundness.

Research issues related to drought mitigation can be broken into two broad questions:

¹ Western Drought Coordination Council's Report to The National Drought Policy Commission.

² Western Governors' Association Drought Task Force Report.

1. How can we efficiently and cost-effectively maintain water input to the production system?
2. How can crops and cropping systems be tailored for efficient and productive use of available water?

Three broad areas of research focus are needed:

- 1) Development of new germplasm resistant or tolerant of drought conditions.
 - a. incorporate traits from existing germplasm into appropriate germplasm
 - b. incorporate genes from non-crop plants (naturally drought tolerant) into crop lines
 - c. develop novel genes and gene systems that enhance drought resistance or tolerance
- 2) Management strategies that effectively exploit available water, increase available water, and match new germplasm.
 - a. develop management systems that overcome limitations to root growth (e.g., increase soil temperature in cool climates, or decrease soil temperature in warm climates, decreased pathogen infection)
 - b. develop systems for enhanced VAM associations with crop plants at low soil water content and high temperature
 - c. develop water harvesting strategies to enhance storage of natural precipitation
 - d. develop strategies to increase infiltration rates, particularly in soils with low organic matter content
- 3) Long range (6 to 12 month) warning of below normal precipitation.
 - a. develop long range predictions of precipitation and temperature based on cyclic atmospheric events that persist beyond individual seasons (e.g. ENSO, North Atlantic Oscillation, Bermuda high)
 - b. collaborate with ongoing global circulation modeling efforts to insure agriculturally relevant parameters are predicted
 - c. develop strategies for the use of inter-decadal precipitation cycles in agricultural management

State Level Needs:

- Each state needs to develop a drought contingency plan that includes early detection, monitoring, decision-making criteria, short- and long-range planning, and mitigation. Programs addressing public awareness and education on drought and water conservation should also be included.
- “The experience in Texas suggests that additional state and federal resources are needed for drought preparedness, response, and mitigation for small water systems. For example, most small water systems do not understand their vulnerability to drought and most do not have drought management plans. As a consequence, many small systems can find themselves in an emergency situation with little or no advance warning and then respond in an ad hoc manner”.²
- The NDMC has determined in talks with all kinds of stakeholders is that a very general definition (such as "a lack of expected water supply") can be appropriate, but that specific definitions need to be applied that are unique to each stakeholder (sector, location, program, etc...). For example, what is "drought" to the governor of South Carolina is going to be different than "drought" to the governor of Nevada. Because of lack of uniformity in definitions, it is critical, then, to have the appropriate triggers established in order to make the necessary decisions. Thus, with triggers, "droughts" can be occurring in both South Carolina and Nevada.

- In Australia, the trigger that is used is that government relief is provided for the "exceptional drought" defined as a 1 in 20 year event (with some additional criteria). There is a need to establish triggers that apply equitably to the agricultural sector of the nation. Should the triggers be regional in focus, or could a program such as FSA have triggers that apply to the entire country? Will the triggers for FSA be the same as the Risk Management Agency (or any other), or is it appropriate to have different triggers. Or should triggers be handled by the states?
- Comprehensive mitigation plans should be prepared at all appropriate levels that includes all affected stakeholders and identifies needs. There is a need to determine who the key players are who will develop the plans, their capabilities and needs for technical and financial assistance based on this assessment. Assistance will be dependent on state and local conditions, and expertise; there is no one step fits all approach. It is important to have educational and motivational components of the program to "sell" the need for a strong mitigation effort.

Local Level Needs:

- With continued growth of communities, long range planning for water supply needs to be built into day-to-day operation that includes consideration of potential drought issues.

During the National Drought Study, US Army Corps of Engineers (USACE) worked with public and private sectors to garner lessons learned from the California drought. One thing that came through strongly is that if an authority announces "we are in a drought" the public hears that (1) something unusual and important is going on and (2) a public response is needed (or else why would they be saying this on TV?). USACE found over 100 definitions of drought and categorized them during the Drought Study. In the end, one could argue that when the word is used in public or in policy discussions, it should mean there is a problem and the public should be prepared to act. Those definitions can only be made regionally after thorough systems analysis.

- Agricultural water suppliers and users need to have an integrated water management plan that incorporates a drought mitigation plan and conservation programs. They also need an effective State/regional drought mitigation plan and supporting programs which are coordinated, in turn, with a coordinated Federal policy and programs.

Tribal Level Needs

Input needed from working groups members of the Intertribal Agriculture Council, DOI-Bureau of Indian Affairs and individual tribes.

Section 4(b)(2). "review all existing Federal laws and programs relating to drought;"

A summary of existing Federal-level programs related to drought is presented as part of Table 1.

Additional Information on Laws or Programs Identified by Federal Members include:

Programs with potential use for drought response in USDA's Farm Services Agency (FSA):
 Environmental Quality Incentive Program (EQIP)
 Emergency Conservation Program (ECP)

Agricultural Conservation Program (ACP)
Conservation Reserve Program (CRP)
Conservation Reserve Enhancement Program (CREP)
Wetlands Reserve Program (WRP)
Noninsured Crop Disaster Assistance Program (NAP)
American Indian Livestock Feed Program (AILFP)
Livestock Feed Programs
 Emergency Feed Assistance Program (EFAP)
 Livestock Preservation Donation Program (LPDP)
 Cash Feed Grain Donation Program (CFGDP)
 Prickly Pear Cactus Burning Program (PPCBP)
Livestock Assistance Program (LAP)
Livestock Indemnity Program (LIP)
Tree Assistance Program (TAP)
Crop Loss Disaster Assistance Program (CLDAP)
Tobacco and Peanuts Program

- The FSA Emergency Loan (EM) Program is available to assist any family farmer who has suffered from any natural disaster. The family farmer must meet all eligibility requirements and have physical and production losses in areas declared by the President, designated by the Secretary, or named for physical loss loans by the FSA Administrator. These eligibility requirements are statutory and contained in the Consolidated Farm and Rural Development Act (ConAct).

The FSA EM Loan Program Regulations, as currently written, are designed to help farmers suffering from any natural disaster. FSA does not have any Farm Loan Program specifically targeted to those farmers suffering from drought. Farmers that raise row crops; are experiencing drought conditions; meet all of the eligibility requirements; and have suffered at least a thirty percent production loss, are eligible for a low interest FSA EM production loss loan of 80% of their actual loss (less any insurance benefits). Farmers whose production comes from trees or other fixture type plants, who suffer from a drought may be eligible for an FSA EM low interest physical loss loan of up to 100% of the physical loss (less any insurance payments). The interest rate for both of these loans is currently 3.75 percent. The terms for the loans range from 1 to 40 years determined by the security offered.

The USDA Risk Management Agency (RMA) administers the programs of the Federal Crop Insurance Corporation (FCIC) which was established in 1938 as an agency within the U.S. Department of Agriculture. The Federal Agriculture Improvement and Reform Act of 1996 placed personnel and the administration of crop insurance programs under RMA. FCIC's Board of Directors and the responsibility for establishing crop insurance programs remain under FCIC which is a wholly owned government corporation.

RMA serves the national interest by improving the economic stability of agriculture through a sound system of crop and revenue insurance products. These insurance products are delivered through private crop insurance agents nationwide. Drought is a covered cause of loss on all policies issued under the authority of the FCIC except those established for irrigated practices. For irrigated acreage, the policies cover failure of the water supply (with restrictions) which is often the result of extended drought.

RMA currently insures more than 70 crops in over 3,000 counties across the United States. Coverage is available on about 75 percent of the annual U.S. farm production value. RMA has targeted further program expansion to make coverage available on 95 percent of the value of annual farm production.

In 1998, RMA provided nearly \$28 billion of liability coverage on over 181 million acres through approximately 1.24 million policies accounting for about \$1.87 billion in premiums. Farmers choose a level of crop insurance. For 1999, a basic 50 percent level of coverage of expected crop yield at 55 percent of the established price is available for an administrative fee of \$60 for each crop. This is known as *catastrophic risk coverage (50/55)* and the premium is subsidized completely by the Federal government. Limited and additional coverage is also available at 5 percent increments up to a maximum of 75 percent of the expected crop yield and 100 percent of the established commodity price based on the amount of risk producers plan to absorb and their own actual production history. This coverage is rated and the producer pays a portion of the premium in addition to the government subsidy. The most widely purchased coverage level is 65/100. In order to encourage participation in the program, all crop insurance premiums are subsidized. Also, agency administrative costs are paid by the Federal government and are not calculated into the premium rate structure.

In the event of crop damage or failure from drought or other covered perils, farmers receive payment equal to the dollar difference between the assessed value of their crop and the dollar value of the amount of insurance coverage selected.

As part of its goal to meet the risk management needs of farmers, RMA has developed and worked with private insurance companies to make several revenue insurance plans available to producers. The Income Protection, Crop Revenue Coverage and Revenue Assurance insurance plans, while differing in their approach, provide a price component to the coverage in addition to the underlying yield coverage.

- The Federal Crop Insurance Act (Act) does not need to be modified to cover drought. Crop insurance is a unique product in relation to most other disaster assistance programs. Unlike other disaster assistance programs, the producer must subscribe to crop insurance in advance of the cause of loss. RMA is carrying out an extensive risk management education program to assist farmers in recognizing their potential for loss, which in drought prone areas would include purchasing adequate insurance to cover potential losses. The Act is currently under review and one of the Administrations proposals deals with multi-year loss occurrences (including drought). Modifications to the Act are expected to provide some relief in this area, which would likely be implemented for the 2000 crop year.

(Bureau of) Reclamation States Emergency Drought Relief Act of 1991

Title I Assistance During Drought

For the 17 USDI-Bureau of Reclamation (USBR) States, only during times of drought by request of Governor or governing body of tribe, the USBR may:

- Undertake on 50/50 cost share basis construction, management, and conservation activities that will minimize losses and damages resulting from drought conditions.

- Provide non-financial assistance to willing buyers in their purchase of available water supplies from willing sellers.
- Purchase water from willing sellers who through conservation or other means have reduced their consumptive demand for water. The water can be used for Federal or state wildlife habitat or sold to recover costs incurred by USBR.
- Make water available and may make USBR facilities available to store or convey project or non-project water for use within and outside authorized project service areas.
- Make water from USBR projects and USBR facilities available on a non-reimbursed basis for the purpose of protecting or restoring fish and wildlife resources impacted by drought.
- Provide loans up to 15 years to water users for the purposes of undertaking construction, management or conservation activities, or the acquisition and transportation of water.
- Title II Drought Contingency Planning
- For the 17 USBR States, for identification of opportunities for water supply conservation, augmentation, and use USBR may:
- Conduct studies to identify opportunities to conserve, augment, and make more efficient use of water supplies available to USBR projects and Indian water resource development in order to be prepared for and better respond to drought conditions.
- Provide technical assistance to States and to local Tribal governments in the development, construction and operation of water desalinization projects including technical assistance for assessing technical and economic feasibility.
- Prepare or participate in the preparation of cooperative drought contingency plans for the prevention or mitigation of adverse drought effects.
- Plans can identify elements appropriate for USBR facilities and non-USBR facilities.
- In September, 1992, EPA and the U.S. Agency for International Development (USAID) issued a manual, "Guidelines for Water Reuse." At this time, there are no uniform national guidelines or standards for water reuse. The 1992 EPA/USAID document reviewed technical issues in planning water reuse systems, types of reuse applications, water reuse regulations and guidelines in the U.S., legal and institutional issues, funding alternatives for water reuse systems, public information programs, and water reuse outside of the U.S. Included in the document is discussion of agricultural water recycling and reuse.

Federal Research on Drought and Drought Related Issues

The USDA Agricultural Research Service (ARS) conducts research to develop and transfer solutions to agricultural problems of high national priority and provides information access and dissemination to:

- ensure high-quality, safe food and other agricultural products,
- assess the nutritional needs of Americans,

- sustain a competitive agricultural economy,
- enhance the natural resource base and the environment, and
- provide economic opportunities for rural citizens, communities, and society as a whole.

The Agricultural Research Service is the principal research agency of the U.S. Department of Agriculture (USDA). ARS is charged with extending the nation's scientific knowledge across a broad range of program areas that affect the American people on a daily basis. The agency's work falls into three main categories: Animal Production, Product Value and Safety, Natural Resources and Sustainable Agricultural Systems, Crop Production, Product Value and Safety. These are further divided into 23 broad national programs. All research projects within the agency are associated with one or more of these national programs. A complete listing of the national programs is provided on the ARS web site at <http://www.nps.ars.usda.gov/programs/table.htm>.

TABLE 00. EPA STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

- In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes careful, efficient use of water, is essential in order to achieve these objectives.
- Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. As we face increasing risks to ecosystems and their biological integrity, the inextricable link between water quality and water quantity becomes more important. Water efficiency is one way of addressing water quality and quantity goals. The efficient use of water can also prevent pollution by reducing wastewater flows, recycling industrial process water, reclaiming wastewater, and using less energy.
- The U.S. Environmental Protection Agency's (EPA) Office of Water strongly encourages all sectors, including municipal, industrial, and agricultural, to achieve efficient water use.
- EPA recognizes that regional, state, and local differences exist regarding water quality, quantity, and usage. Differences in climate, geography, state institutions, and laws favor a prudent approach in which water efficiency programs are tailored for specific locales.
- To promote efficient water use, EPA's primary role is to provide technical assistance and information concentrating on 1) improved management practices, 2) better science, 3) effective planning and coordination, 4) market incentives, and 5) public education.

Section 4(b)(3). “review State, local, and tribal laws and programs relating to drought that the commission finds pertinent;”

Written contributions from Agr. Working Group Federal members include:

- In the U.S., the States have taken various approaches to water reuse regulations; Arizona, California, Florida and Texas have regulations that strongly encourage water reuse as a water resources conservation strategy. Based upon available information (that is current as of March 1992), 19 States have regulations or guidelines for water reuse for food crops and 35 States have regulations or guidelines for water reuse for non-food crops.

- The Federal crop insurance program preempts non-Federal laws and regulations. Through the Risk Management Education program RMA is actively working with Native Americans and other groups to address under served areas.
- Specifically for California- Municipal and Industrial water districts must prepare water shortage contingency plans. Guidebook has been prepared but little technical assistance is available from the state. Agricultural water districts have no similar requirement. Water shortage contingency plans are required of all Federal water contractors in the Central Valley Project but mitigation is not emphasized.
- Specifically for Hawaii- the USDI Bureau of Reclamation can provide planning assistance to the state of Hawaii under the current authorization, but can not provide funding since Title I specifically applies to the 17 Western states on which Hawaii is not included.

Section 4(b)(4). “determine what differences exist between the needs of those affected by drought and the Federal laws and programs designed to mitigate the impacts of and respond to drought;”

Written contributions from Agr. Working Group Federal members include:

- The Farm Service Agency Emergency Loan Program as written and implemented is not adequate to assist most family farmers and ranchers in America who are currently or have recently suffered from the devastating results of drought. Farm Service Agency does not include provisions for a low- interest Farm Loan Program, designed to assist those family farmers and ranchers suffering from a drought, particularly livestock ranchers. Often during a drought emergency ranchers are forced into increased culling. One alternative for the rancher is the purchasing of feed for the cattle. This is very expensive and causes a loss in profits. Another alternative is to keep the same herd size on decreased forage, which will result in much lower calf market weights and percentage of cows settling during the calving heat. This will also result in fewer calves produced in the following year. Unfortunately, all of these alternatives are considered management decisions and therefore the rancher is not eligible for FSA EM loans for drought designated disasters.
- A fundamental issue is drought response time and strategic preparation. Federal and State agencies do not have a plan of coordination developed prior to a drought. Each drought program has different eligibility criteria. Response times vary from one program to the next. Program triggering mechanisms should be standardized.
- Policy needs to be developed to promote drought contingency planning, emphasizing a more proactive, anticipatory approach to drought management.
- There is no standard definition of drought, among all levels of government (federal, state, regional, and local). On the other hand, it would be difficult to identify independent or objective physical criteria that specify when drought conditions exist.
- Drought funds should be shifted from drought relief to drought preparedness and mitigation. We do not have an effective drought risk management program. Farmers and ranchers need to adopt

a more self-reliant approach to managing climatic variability. We need to ensure risk management tools are available to all farmers and ranchers to make them more self-reliant.

- A change in policy requires time for communication and change. Farmers and ranchers need to be engaged in the policy process.

There is no national drought plan. The states must develop their own plans for collecting, analyzing and disseminating information on drought conditions. State plans should be linked to the national plan through interagency committee(s) with drought designation responsibility and program administration.

As producers diversify into nontraditional crops and livestock in response to market changes, program flexibility, risk reduction, etc., USDA must assure that non-traditional commodities, when raised for commercial production, are provided with an adequate safety net.

Provide outreach to small, limited resource and undeserved farmers, who often raise non-traditional crops, to assure all producers have equal access to USDA programs.

A fundamental issue is drought response time and strategic preparation. Federal and State agencies do not have a plan of coordination developed prior to a drought. Each drought program has different eligibility criteria. Response times vary from one program to the next. Program triggering mechanisms should be standardized.

Policy needs to be developed to promote drought contingency planning, emphasizing a more proactive, anticipatory approach to drought management.

Develop a standard definition of drought, among all levels of government (federal, state, regional, and local).

Drought funds could be shifted from drought relief to drought preparedness and mitigation.

Develop an effective drought risk management program. Farmers and ranchers need to adopt a more self-reliant approach to managing climatic variability. We need to ensure risk management tools are available to all farmers and ranchers to make them more self-reliant.

Develop a national drought plan. The states must develop their own plans for collecting, analyzing and disseminating information on drought conditions. State plans should be linked to the national plan through interagency committee(s) with drought designation responsibility and program administration.

- FSA programs dealing with crop losses associated with drought primarily relate to replacing lost income. Funding of such programs are often ad hoc. A more permanent funding source would enable farmers, ranchers, and bankers more financial certainty.
- Enhance programs that the Secretary can authorize when making a Secretarial Declaration by developing an expedited emergency response procedure impacting Emergency Loans, Noninsured Crop Disaster Assistance Program, livestock assistance, tree assistance, and dairy assistance programs. Establish a common trigger that activates all programs. This would require statutory and regulatory change.

- Change statutory language that requires the producer to choose between benefits available under multiple disaster programs.
- Allow producers to collect multiple benefits from multiple programs, and cap the payments at the value of the producer's economic loss.
- Expand authorities under the Emergency Conservation Program (ECP) and the Tree Assistance Program (TAP). Consider such changes as using CCC funds in lieu of an appropriation, provide for permanent authorization of TAP, increase the cost-share under TAP, and authorize tree planting under ECP.
- Train farmers to be more active risk managers.
- Develop a data base of program costs associated with drought and other weather-related disasters. Project program costs associated with drought and reflect in the budgeting process.
- Encourage statutory authority for programs which have been suspended or sunset e.g. livestock feed assistance programs, Indian Acute Disaster Distress Program.
- Encourage Federal, Tribal and State partnerships, including shared program funding, to the maximum extent possible.
- Assess if drought mitigation criteria can be incorporated into existing disaster assistance programs.
- Assure that adequate resources are available to fund and administer programs.
- Using existing technologies to track, verify, model and predict drought, its expansion, contraction and impact on various commodities, agribusiness, families and communities.
- Develop a framework that integrates actions and responsibilities among all levels of government (federal, state, regional, and local). This policy should plainly spell out preparedness, response, and mitigation measures to be provided by each entity.
- Develop a State drought contingency plan that includes early detection, monitoring, decision-making criteria, short- and long-range planning, and mitigation. Programs addressing public awareness and education on drought and water conservation should also be included.
- The drought response authority is very limited for the NRCS Emergency Watershed Protection Program (EWP). A legal analysis is needed of the EWP authority for drought and options considered for its implementation. For example, NRCS may be able to request supplemental community assistance funds when a drought is declared for rural water supply.
- Drought mitigation or response is not emphasized purposes of the new NRCS conservation programs such as EQIP, WHIP, WRP, and Farmland Conservation. Drought needs to be re-emphasized as a potential activity in locally led *conservation* or on farm planning as alternative practices such as cultivation methods and crops are considered for farm management systems. *Conservation* practice standards also need to be updated for drought preparation, mitigation, and response concerns.

- The International Drought Information Center conducted a survey in 1992 on how NRCS (*formerly the Soil Conservation Service*) is “fostering the adoption of drought mitigation measures by farmers, ranchers, rural community residents, and others”. Attachment 1 lists the recommendations of forty-four states on what changes in NRCS programs and policies would be most useful for improving NRCS ability to help farmers reduce their risk of exposure to drought hazards. The responses range from changes in what NRCS promotes for irrigation management practices to changes in what they *recommend* for water management for rural communities.

(NRCS2, J.Frost, 5/99)

Attachment 2 lists recommendations of the forty-four states on how NRCS should help farmers and ranchers *respond to droughts while preserving* environmental quality. These recommendations range from which farm practices help the most to legal/institutional changes that are needed.

(NRCS2, J.Frost, 5/99)

Attachment 3 lists recommendations of the forty-four states on how NRCS could improve *and promote* its practice standards and assistance activities for drought mitigation. These recommendations range from changes in the emphasis of drought consideration in the planning process to better training of NRCS personnel.

(EPA, G.Hudiburgh, 5/14/99)

The EPA recommends that there needs to be some discussion of quality of water for various agricultural uses/needs, as well as public perceptions of use of recycled/reused water for agricultural uses/needs.]

The Federal government could play an increased role in recycle/reuse of water in agriculture by public education and outreach, and leadership role by use of recycle/reuse water itself in its ag areas. [This last concept is likely something that the US federal government already does.] DOI Bureau of Reclamation has done considerable work in California.

(RMA1, 5/99)

Producers are adversely affected and currently under protected from multi-year reductions in insurance guarantees due to repeated losses and erosion of producers’ historical yields as a result of this decline. As discussed above, this issue will be debated in the current session of Congress.

(Department of the Interior, USDI Bureau of Reclamation, T. Slavin 5/99)

Stakeholders should be provided with a clear understanding of what federal agency assistance is available. It is important to identify what federal programs exist and how state and local agencies can utilize the assistance while minimizing duplication.

Section 4(b)(5). “collaborate with the Western Drought Coordination Council and other appropriate entities in order to consider regional drought initiatives and the application of such initiatives at the national level”;

Written contributions from Agr. Working Group Federal members include:

- Develop a national drought policy or framework that integrates actions and responsibilities among all levels of government (federal, state, regional, and local). The policy should plainly spell out preparedness, response, and mitigation measures to be provided by each entity.
- “The activities initiated by the WDCC could be emulated in the remainder of the country as part of a coordinated national effort. With much of the infrastructure already begun through the WDCC’s

efforts, a national oversight group could provide a clear mandate, management, and resources which would ensure success for a variety of drought related activities on a national level.”¹

- (Coordination, rather than oversight, may be what is needed so that the existing Federal and state agencies and private sector organizations may be able to function more efficiently.)
- “The WDCC recommends that the National Drought Policy Commission (NDPC) consider linking the national oversight group to regional groups for program delivery. Drought and other water issues have greatly different physical characteristics, impacts, political response mechanisms, and thus informational needs, from region to region. These regional perspectives should utilize existing institutions such as the Regional Climate Centers.” ¹
- “NDPC should support the establishment of a statutorily designated lead federal agency, adequately funded, that would coordinate communication and cooperation among the various regional groups, to ensure an absence of duplication and the encouragement of complimentary actions including establishment of a clearing house, with possible regional sub-sections”. ¹
- The Commission should give consideration to implementation of recycle/reuse guidelines for ag on a river basin or watershed basis; the needs for and eventual end uses of the water can and does vary in different river basins and watersheds.
- The Commission should assess the need to become more active in promoting risk management and the crop insurance program as a means of mitigating the economic impact of drought.
- The Commission should give consideration to implementation of recycle/reuse guidelines for ag on a river basin or watershed basis; the needs for and eventual end uses of the water can and does vary in different river basins and watersheds.
- Different entities including water user authorities, tribes, resource conservation districts etc. can be effective players in developing and implementing drought preparedness, response and mitigation efforts.

Other written contributions from Working Group Federal members on those questions which must be answered by the Commission included:

SECTION 4 (B) 6 Options to Recommend how Federal drought laws and programs can be better integrated with ongoing State, local, and tribal programs into a comprehensive national policy to mitigate the impacts of and respond to drought emergencies without diminishing the rights of States to control water through State law and considering the need for protection of the environment.

(USDA_FSA/DAPHE B. Karmen 6/99)

USDA is building the capability to warehouse geospatial information on the nation's farm and ranch land. The data will include land use information, such as soils, crops, wetlands, easements, conservation practices, watershed boundaries, and many others. Once collected, this information could be a valuable tool to support analyses of the economic impact that droughts could have in defined areas. Real time weather data could also be overlayed on the geospatial data to serve as an early warning diagnostic tool and to identify mitigation opportunities. This capability will become available in increments over the next seven years and will likely evolve into a critical information sharing opportunity for the public and private sector.

Organizations such as the Western Governors Association Task Force on Drought and the NDPC are vital organizations which can drive change to assure common responses and policy before the impacts of the drought become critical.

An organizational structure similar to the NDPC could be established within the varied Departmental organizations to assure USDA speaks with a common voice in response to all disaster events. As applicable, provide Federal assistance in conjunction with and through State, local, and tribal programs on a grant or cost share basis.

(NRCS2, J.Frost, 5/99)

Incentives should be established for some types of Federal drought preparation and mitigation programs. Federal drought assistance could be larger or have more favorable cost shares for states, conservation and water districts, private land owners, and other entities that have adopted drought plans or included drought as a primary resource concern to consider during planning.

NRCS needs to include drought preparation, mitigation and response on an equal basis with other *resource concerns or purposes* in its *area wide conservation* and watershed planning and on farm planning. NRCS needs *increased funding* for conservation technical assistance for droughts during these planning activities. This assistance should include updating practice standards for drought, increasing the use of water resource analysis tools, and obtaining better crop management tools for droughts.

(EPA, G.Hudiburgh, 5/14/99)

Drought policy should be implemented on a watershed basis because of the innate advantages of this approach and because of the growing trend toward watershed management in the U.S. The policy should integrate research, planning, management, and sustainable development. Principles of social equity, environmental protection, and participatory decision-making should be stressed in drought mitigation and response programs. More emphasis placed on mitigation programs than is currently the case.

(Department of the Interior, USDI Bureau of Reclamation, T. Slavin 5/99)

The following are desired outcomes:

1. Insure preparation of Drought Mitigation Plans at all pertinent levels including state, public agency and on-farm.
2. Insure that planning entities and end users have access to state of the art drought forecasts in order to optimize drought response efforts.
3. Insure that drought response is consistent with overall state, tribal and local land use policy and should be careful not to reward individuals who do not conform to those land use policy.

SECTION 4(B) 7 Options to recommend improving public awareness of the need for drought mitigation and prevention; and response on developing a coordinated approach to drought mitigation, prevention, and response by governmental and non-governmental entities, including academic, private, and nonprofit interests; and,

(USDA_FSA/DAPHE B. Karmen 6/99)

Provide coordinated (Federal, State, local, and tribal) public service programs regarding the availability of water (surface and ground), the effects of heat on all aspects of the environment, and the availability of government programs to mitigate the effects of drought. Train farmers to be more active risk managers.

Provide federal funding for the National Drought Mitigation Center to assist states with drought preparedness, planning, and mitigation. This center should serve as a clearinghouse for information on mitigation, planning, and preparedness activities; provide a regional/national climate monitoring system; and develop a national/regional database of state drought response resources.

(NRCS2, J.Frost, 5/99)

Increase drought educational material available *to conservation partners such as conservation districts, Resource Conservation and Development Councils and state organizations. NRCS state offices need to establish communication plans to encourage voluntary planning for droughts by private land owners.*

(EPA, G.Hudiburgh, 5/14/99)

Public awareness and support is critical for agricultural water suppliers and users to successfully implement recycle/reuse. Included in this effort is the need for education of the safety of agricultural products through use of water that meets minimum standards. [This is in no way an attempt by EPA to impose upon any Indian Tribe recycle/reuse requirements inconsistent with any Tribal cultural and/or religious beliefs.] The Federal government, States, and Tribes can assist by coordinating their information dissemination efforts.

(Department of the Interior, USDI Bureau of Reclamation, T. Slavin 5/99)

Well-recognized national clearinghouse is important. The National Drought Mitigation Center is well suited to this role and should be duly supported. It will also be of value to maintain and establish strong state lead information sites as part of this program.

SECTION 4(B)8 Options to Recommend whether all Federal drought preparation and response programs should be consolidated under one existing Federal agency and, if so, identify such agency.

(USDA_FSA/DAPHE B. Karmen 6/99)

USDA –FSA believes that it would be advantageous to have one Federal agency coordinate implementation of Federal drought mitigation and response activities. The possibility of establishing a superfund for drought related assistance should be explored.

Establish a multi departmental group similar to the Federal Emergency Management Agency (FEMA) long term recover task force, for drought coordination with states and regional agencies. This group should determine the federal's government's role in drought response and mitigation. They should also seek to focus federal response and information so that states and local governments have access to "one-stop shopping".

Identify the available family of Federal programs which can be activated as the severity as a drought deepens.

Assure programs are offered in a coordinated, non duplicating manner.

Establish a central USDA point of contact where producers and other Federal and State agencies can obtain accurate and timely information on available assistance. (Drought assistance is offered under several USDA programs.)

Issue status and action reports as a drought deepens and expands.

(NRCS2, J.Frost, 5/99)

It would be very difficult to consolidate all Federal drought preparation and response programs under a single Federal agency. Many programs are integral components of larger programs that have other purposes, sponsors, participation rules, and methods of delivery. Two examples are the many purposes besides drought that are served by water management practices on farms and operating rules of dams. Droughts are identified and responded to in different ways for various water users such as communities, industry, navigation, agriculture, recreation, and environment. The methods for monitoring and determining when there is a drought differs for each of these water users. Agriculture drought occurs when crops cannot utilize the soil moisture or farmers can no longer make a profit.

It would be useful to *have a Federal agency as a single point of contact or coordinator for Federal*

agencies with drought responsibilities. *Agency representatives could serve for two years on a core drought response staff at the single Federal agency. Special drought teams could be assembled for responding to major droughts once they are declared or a separate team could be on call for each region of the country. The type of impacts of each drought--municipal and industrial, agriculture, environment, and transportation--would determine which agencies/programs would send its people to each team.*

It would be very useful to collect a core group of response programs under a single agency. These programs would be aimed at similar types of water users and droughts such as agriculture and rural water supply. This would allow more efficient and effective coordination among these programs'
1) drought declaration formulas, 2) data collection and interpretation, 3) response teams, and 4) cost sharing formulas.

(EPA, G.Hudiburgh, 5/14/99)

The Federal drought program in the 17 Western States should be consolidated under the Department of Interior. The drought program for the remaining States should be consolidated under the Department of Agriculture. All programs should be reoriented on a watershed basis.

(Department of the Interior, USDI Bureau of Reclamation, T. Slavin 5/99)

The federal agencies are structured and staffed to interact with different constituencies. For instance the U.S. Bureau of Reclamation works primarily with water districts and tribes and has programs and authorities to assist those entities. The USDA's National Resource Conservation Service has historically targeted on-farm concerns with programs and authorities to meet the individual farmers needs. To house all programs under one agency umbrella would not be effective in delivery all federal assistance because the specific agencies have unique expertise and relationships with specific stakeholders which allows them to best implement the drought programs they have been authorized to carry out.

However, many of these programs have areas of duplications and do require coordination. This could best be handled by naming a lead agency to coordinate efforts and determine where deficiencies exist and additional programs should be developed.

SELECTED REFERENCES

OECD. 1996. Environmental Performance Reviews: United States. 274 pages, Organisation for Economic Cooperation and Development, 2 rue Andre-Pascal, 75775 PARIS CEDEX, 16 France.

L. K. Dyson. 1988. History of federal drought relief programs. US Department of Agriculture, Economic Research Service, ERS Staff Report No. AGES880914. 10 pages.

Wilhite, D.A. 1993. Drought Mitigation Technologies in the United States: With Future Policy Recommendations. Final report of a cooperative agreement. IDIC Technical Report 93-1. 141 pages.

APPENDIX A. List of Acronyms Used in This Report

ARS	Agricultural Research Service, USDA
BOR	USDI Bureau of Reclamation (see also USBR)
EPA	US Environmental Protection Agency
FSA	Farm Services Agency, USDA
FS	Forest Service, USDA
NRCS	Natural Resources Conservation Service, USDA
USBR	Bureau of Reclamation, USDI (see also BOR)
USDA	US Department of Agriculture
USDI	US Department of the Interior

APPENDIX B. List of Federal Members of the Agriculture Working Group

(See list preceding the report)

APPENDIX C. List of Federal Research on Drought-Related Problems

US DEPARTMENT OF AGRICULTURE

Agricultural Research Service. Included below is a less than exhaustive list of ARS research projects relating to drought. (A more complete list is being developed.):

Project Name: **DEVELOPMENT OF SOYBEAN GERMPLASM AND PRODUCTION SYSTEMS FOR HIGH YIELD & DROUGHT PRONE ENVIRONMENTS**

Project # 3607-21000-004-00D; Mode Code 3607-15-00

Midwest Area - Corn & Soybean Research

Principal Investigator: RICHARD COOPER

Williams Hall, OARDC, Room 218

1680 Madison Avenue

Wooster, OH 44691-4096

Voice: 330-263-3875; Fax: 330 263-3887; E-Mail: cooper.16@osu.edu

OBJECTIVES: Identify physiological/genetic constraints to higher soybean yields and develop germplasm and production systems that will maximize the biological efficiency of soybeans when grown in highly productive, irrigated environments, and in low-yielding, drought-prone environments, within the constraints of maintaining the quality of the environment.

APPROACH: In addition to normal agronomic traits, important physiological traits such as photosynthesis, plant water status, nitrogen status and cold tolerance will be measured to identify genetic, environment and management effects. This knowledge will be used to develop soybean germplasm with specific adaptation to high yielding and drought prone environments, and in the evaluation of management systems to increase soybean yields. Disease, insect and nematode resistance will be incorporated into elite germplasm lines. Water quality will be monitored in the high yield, high input system to ensure water quality is being maintained.

Project Name: **PHYTOCHEMICAL RESPONSES TO ENVIRONMENTAL STRESS: IMPLICATIONS FOR GLOBAL CHANGE AND NUTRITION**

Project # 1270-11210-006-00D; Mode Code 1270-25-00

Beltsville Area - Natural Resources Institute - Climate Stress Laboratory

Principal Investigator: BRITZ, Steven .J

BLDG 046A BARC-WEST

10300 Baltimore Blvd.

Beltsville, MD 20705-2350

Voice: 301-504-5607; Fax: 301 504-6626; E-Mail: sbritz@asrr.arsusda.gov

OBJECTIVES: Identify the effects, separately and in combination, of atmospheric CO₂, solar radiation, air quality, temperature, soil moisture and mineral content on a suite of phytochemical compounds. Evaluate the role of these compounds in the tolerance/resistance of crops to chronic and acute environmental stress under ambient and expected future levels of atmospheric CO₂. Evaluate the implications of environmental stress and global change on the phytonutrient content of crops.

APPROACH: Interactions between atmospheric CO₂ levels and multiple environmental stresses (both chronic and acute) will be investigated in controlled environments or open-top chambers in the field, adjusting or monitoring atmospheric CO₂, soil moisture and pH, mineral nutrition, actual or simulated solar radiation, temperature, and air pollutant levels. A range of crops will be studied, including soybeans, wheat, forages, green leafy vegetables, cucumbers, tomatoes, and small fruits.

Important phytochemical constituents including ascorbic acid, dehydroascorbic acid, carotenoids, flavonoids, sterols, and fatty acids, will be extracted from seeds, fruits or leaves, analyzed enzymatically or by HPLC, and inventoried for a range of environments. Antioxidant properties of specific compounds will be assayed to assess qualitative and quantitative changes in composition. Stress-tolerant/resistant lines of crops will be compared to sensitive ones to evaluate the significance of differences in phytochemical composition. Effects of environment on biosynthetic pathways will be evaluated.

Project Name: **AGROFORESTRY SYSTEMS FOR THE APPALACHIAN REGION**

Project # 1932-21610-001-00D; Mode Code 1932-05-00

North Atlantic Area - Appalachian Farming Systems Research Center

Principal Investigator: Carol Schumann

1224 Airport Road

Beaver, WV 25813-9423

Voice: 304-256-2832; Fax: 304-256-2921; E-Mail:

cschumann@afsrc.ars.usda.gov

OBJECTIVES: To evaluate the coupled production of trees and understory species to optimize the economic and environmental integrity of Appalachian farms. Specifically: 1) Develop tree/forage/specialty crop systems with emphasis on filling high value niche markets and providing raw materials for associated value added enterprises, and 2) Determine competitive and synergistic mechanism by which agroforestry systems partition sunlight, nutrients, and water for developing improved management strategies.

APPROACH: Various tree species of interest will be planted on appropriate pasture sites that vary in soil type, soil depth, landscape position and elevation. Forested sites will be thinned or cleared in narrow east-west strips and managed for high value understory specialty crops. Growth by tree species and understory species will be evaluated to determine optimal tree density for various soil and microclimate site characteristics. Water, solar radiation and nutrient budgets will be analyzed on a temporal and spatial basis to identify opportunities to increase the productivity of these species diverse agroforestry systems. Particular attention will be given to the impact of tree utilization of water and cycling of nutrients from depths below the availability range for understory species. In addition to studying the dynamics of resource competition, allelopathic and synergistic effects will be analyzed to develop a species compatibility rating system. Attention will also be paid to species combinations that facilitate natural biological suppression of pests and diseases.

Project Name: **IDENTIFYING AND MANIPULATING DETERMINANTS OF PHOTOSYNTHATE PRODUCTION AND PARTITIONING**

Project # 3611-21000-010-00D; Mode Code 3611-30-00

Midwest Area - Photosynthesis Research

Principal Investigator: Donald Ort

1201 W Gregory Dr. Rm. 148

Urbana, IL 61801-3838

Voice: 217-333-2093; Fax: 217-244-0656; E-Mail: d-ort@uiuc.edu

OBJECTIVES: The research effort will be focused in three major areas. I. Regulation of partitioning and determinants of sink strength; II. Environmental limitations on photosynthetic performance/productivity; III. Limitations in resource acquisition and allocation in transgenic plants engineered to produce novel products or overproduce natural products.

APPROACH: The scope of this Research Project is broad, containing several distinct projects, requiring application of diverse theories and the use of a wide range of techniques and

methodologies. Required techniques, procedures and methodologies include: a wide range of biochemical isolations of cellular components, conventional and kinetic absorption and fluorescence spectroscopy, procedures for measuring photosynthesis in intact leaves, in isolated chloroplasts and in an array of subchloroplast membrane preparations, ion specific and polarographic electrodes, computer analysis of kinetic data, nucleic acid and protein blotting, in vitro mRNA translation, nuclear run off transcription, antibody production, enzyme kinetics, plant genetics, yeast genetics, plant transformation, and organic synthesis. Certified by U of I IBC for Biosafety Level 1 on May 12, 1998 for work in rooms 196 and 77 ERML. CRIS project covering all work in Research Unit was determined to be 10 percent of effort in biotechnology after consolidation of 3 CRIS(s) into 1.

Project Name: INTEGRATED CONTROL OF ASPERGILLUS FLAVUS AND AFLATOXIN IN THE MIDWEST CORN BELT

Project # 3620-42000-015-00D; Mode Code 3620-35-00

Midwest Area - National Center for Agricultural Utilization Research - Bioactive Agents Research

Principal Investigator: Donald Wicklow

NCAUR-ARS-USDA

1815 N. University St. Room 3204

Peoria, IL 61604-3999

Voice: 309-681-6243; Fax: 309-681-6686; E-Mail:

wicklodt@mail.ncaur.usda.gov

OBJECTIVES: Control *Aspergillus flavus* infection and aflatoxin contamination of preharvest corn in the midwest through an integrated approach to disease management.

APPROACH: Identify structural, chemical and biochemical resistance factors in corn; develop diagnostic methods enabling breeders to monitor the transfer of resistance factors; determine if resistance factors are altered by drought/temperature stress; investigate naturally occurring, non-aflatoxin producing *A. flavus* populations and necrotrophic yeasts in preventing aflatoxin contamination; develop control strategies for sap beetle vectoring of *A. flavus*; incorporate data on weather, corn insects, *A. flavus* populations and corn hybrid susceptibility to produce a predictive model. NCAUR, Peoria, IL, BAR Labs, Rms 2302, 2304, 2312, 2318; BL-1; IBC Recertified, 3/11/98.

Project Name: GERmplasm IMPROVEMENT AND AGRONOMIC DEVELOPMENT OF NEW ALTERNATIVE INDUSTRIAL CROPS

Project # 5344-21410-002-00D; Mode Code 5344-20-10

Pacific West Area - U.S. Water Conservation Laboratory - Environmental and Plant Dynamics Research

Principal Investigator: Francis Nakayama

4331 E Broadway Rd

Phoenix, AZ 85040-8832

Voice: 602-379-4356; Fax: 602-379-4355; E-Mail:

fnakayam@uswcl.ars.ag.gov

OBJECTIVES: Acquire and characterize germplasm of guayule, lesquerella, vernonia, and other promising new, alternative crops. Evaluate and enhance germplasm of new crops for industrial raw materials. Develop knowledge of floral biology and seed production and plant responses to stresses. Develop economical cultural and production systems for new crops under various conditions. Develop methods for efficient guayule latex extraction and seed oil analyses for characterizing latex, resin, and oil properties.

APPROACH: The evaluation and improvement of new-crop germplasms will be conducted concurrently with the development of appropriate crop production practices. Since timetables are difficult to conduct for new crops, frequent reviews for achieving the objective will be conducted and appropriate changes made to maximize efficient use of personnel and resources. Replaced 5344-21410-001-00D (10/95).

Project Name: **MOLECULAR AND PHYSIOLOGICAL TECHNIQUES FOR IMPROVING SEMIARID RANGELAND AND PASTURE PLANTS**

Project # 5428-21000-006-00D; Mode Code 5428-10-00

Northern Plains Area - Forage and Range Research

Principal Investigator: N.J. Chatterton

Forage & Range RL

696 N 1100 E

Logan, UT 84322-0000

Voice: 435-797-2249; Fax: 435-797-3075; E-Mail: NJCHATT@cc.usu.edu

OBJECTIVES: Develop knowledge of C and N metabolism; using molecular techniques identify genetic markers and define processes limiting photosynthesis, carbohydrate partitioning, nitrogen assimilation, seedling vigor, persistence and production in forage plants exposed to environmental stresses; determine relationships between plants and parasitic nematodes; translate new knowledge into efficient screening procedures. Develop improved plants for enhanced conservation, water quality, and forage production.

APPROACH: Key traits and metabolic processes of range and pasture plants, including carbon isotope discrimination, drought tolerance, salt tolerance, assimilate partitioning, plant competition, grazing tolerance, cool temperature growth, seedling establishment, plant persistence, rooting characteristics, nutrient uptake and assimilation, and resistance to nematodes will be measured, studied (including molecular approaches), and used to evaluate and select improved plant materials.

Research will be effected in a cooperative germplasm enhancement effort with plant geneticists and breeders. Knowledge of biochemical and physiological mechanisms will be used to develop new and more efficient selection criteria for effective germplasm improvement. Plant responses to environmental stresses and resistance to nematodes will be modified through breeding and selection to provide plants better adapted on the millions of acres of parklands/recreational areas and semiarid rangelands in the western U.S. Logan, UT, FRRL Lab, Rms 110, 117&23. Code: BL-19/7/97

Project Name: **GERMPLASM COLLECTION, EVALUATION, ENHANCEMENT AND BREEDING OF PLANTS ADAPTED TO SEMIARID REGIONS**

Project # 5428-21000-007-00D; Mode Code 5428-10-00

Northern Plains Area - Forage and Range Research

Principal Investigator: Kay Asay

696 N 1100 E

Logan, UT 84322-0000

Voice: 435-797-3069; Fax: 435-797-3075; E-Mail: KHASAY@cc.usu.edu

OBJECTIVES: Evaluate genetically diverse germplasm. Apply breeding and molecular procedures to develop improved grasses and legumes for resource conservation, low-maintenance turf and grazing by wildlife and livestock on semiarid rangelands and irrigated pastures. Utilize cytological and molecular technology to develop genetic markers and gene maps for range and pasture species, and to effect intergeneric genetic exchange and fix gene combinations to maximize heterosis in grass/cereal species.

APPROACH: Collect germplasm throughout temperate rangelands of North and South America, Europe, and Asia to establish a biologically diverse germplasm base. Important germplasm will be evaluated and characterized. Hybridization, induced polyploidy and unique laboratory and field screening procedures will be used to develop germplasm and cultivars for temperate semiarid rangelands and irrigated pastures with improved nutritional qualities, water-use efficiency, productivity of forage and seed, seedling vigor, drought stress, grazing potential during the late fall and winter, resistance to biotic and abiotic stresses, and reduced anti-quality potential. Drought-resistant grasses will be developed for low-maintenance turf and conservation in water-limited environments. Molecular techniques will be used for cultivar identification and to mark and map genes conditioning important traits. Genetic introgression with perennial Triticeae will be pursued to fix superior gene combinations in cereals and rice. Biotech: Logan,UT; FRRL, RM121&122; Code# BLP-1 9/7/97.

Project Name: **LOW RISK MANAGEMENT STRATEGIES FOR SUSTAINING
RANGELAND AGRICULTURE IN THE NORTHERN GREAT PLAINS**

Project # 5434-11210-003-00D; Mode Code 5434-05-00

Northern Plains Area - Range and Livestock Research

Principal Investigator: Marshall Haferkamp

Ft. Keogh LARRL

Rt. 2 Box 2021

Miles City, MT 59301-9202

Voice: 406- 232-8211; Fax: 406-232-8209; E-Mail:

marshall@larri.ars.usda.gov

OBJECTIVES: For the mixed grass prairie in the Northern Great Plains quantify role of rangelands & management in regulating atmospheric carbon dioxide flux; identify ecological mechanisms and quantify impact of livestock grazing on long-term sustainability; quantify role of planted forages on ecological & economic sustainability of beef cattle industry; & elucidate interaction effects of soil water & nitrogen on herbage production & plant species composition between indigenous perennial & alien annual grass species.

APPROACH: Field-laboratory studies will evaluate how plants respond to grazing and environmental stress. Role of rangelands and management tactics in regulating atmospheric carbon dioxide flux will be assessed by measuring temporal changes in plant biomass, soil organic matter and water, and carbon dioxide fluxes with both a Bowen-Ratio Unit and 1m**3 chambers. Long-term impacts of environment on ecological condition will be assessed by evaluating changes in plant species composition inside and outside livestock exclosures and evaluating changes in herbage production and rooting dynamics with short-term droughts applied with a rain-out shelter. The potential role of planted forages will be studied by monitoring herbage growth dynamics, cattle diets, & weight gains. Plant and community responses to interactions of varying levels of soil water and nitrogen will be assessed in field and greenhouse studies by measuring plant water relations, phenological development, and above- and below- ground biomass production at selected time intervals.

Project Name: **GENOMIC RELATIONSHIPS AND GERmplasm ENHANCEMENT
OF WHEAT BY CLASSICAL AND MOLECULAR TECHNIQUES.**

Project # 5442-21000-017-00D; Mode Code 5442-05-25

Northern Plains Area - Red River Valley Agricultural Research Center - Cereal Crops Research

Principal Investigator: Prem Jauhar

Northern Crop Science Lab

1307 N 18th ST

Fargo, ND 58105-5677

Voice: 701-239-1309; Fax: 701-239-1369; E-Mail:

jauharp@fargo.ars.usda.gov

OBJECTIVES: Improve wheat germplasm through the transfer of desirable traits, including disease resistance, salinity resistance or tolerance, drought tolerance, and improved quality, to wheat from the Triticeae grasses; improve techniques for making wide crosses within Triticeae; and provide a better understanding of genome relationships, gene introgression, and fertility restoration in wide crosses; wheat germplasm enhancement by direct introduction of alien genes by biolistics.

APPROACH: Conventional and improved procedures will be used to produce interspecific and intergeneric hybrids of wheat and related Triticeae species. Growth regulators, embryo rescue, appropriate culture methods, chromosome doubling techniques, and appropriate crossing, backcrossing, and selection procedures will be used to facilitate production of wheat plants with desirable alien genes. Cytogenetic procedures will be used to verify production of hybrids and study chromosome pairing, and provide information on genome relationships. Derived amphiploids will be evaluated for meiotic regularity and reproductive stability and used for further breeding and selection experiments. Diploid and tetraploid species of Triticeae will be intercrossed to produce hybrids and amphiploids for use as bridges in crosses with wheat. Wheat germplasm enhancement will also be effected by direct introduction of alien genes into regenerable scutellum callus using microprojectile bombardment.

Project Name: **DEVELOPMENT OF INTEGRATED AND SUSTAINABLE FORAGE-LIVESTOCK SYSTEMS FOR THE NORTHERN GREAT PLAINS.**

Project # 5445-21000-005-00D; Mode Code 5445-05-10

Northern Plains Area - Northern Great Plains Research Laboratory - Natural Resource Management Research

Principal Investigator: Albert Frank

North Great Plains RL, Bldg 3

Hwy 6 S

Mandan, ND 58554-0000

Voice: 701-663-3007; Fax: 701-667-3054; E-Mail: FRANKA@ars.usda.gov

OBJECTIVES: Quantify plant and soil processes that affect forage establishment, nutritive quality, and productivity, and plant responses to temperatures, drought, global climate change, soil nutrients, diseases, and other stresses that determine the sustainability of forages. Develop management practices that incorporate improved forage germplasm and reduce competition from weeds into dryland forage-crop-livestock systems that will provide high quality forage over an extended grazing period.

APPROACH: Study response of improved grass cultivars to soil water and N in a rain shelter by evaluating water use-efficiency, nutritive value, plant development using growth stage scales and agronomic and physiological attributes. Evaluate the effect of management practices imposed on grasslands on the global carbon balance using the carbon dioxide Bowen ratio energy balance technique to measure carbon dioxide fluxes over time. Study leafy spurge control through multispecies (cattle and sheep) grazing. Evaluate the dynamics of the soil seedbank of weedy species in development of weed management strategies for crop and forage systems. Graze improved and native pastures with yearling steers in a free choice design to evaluate animal selection preference, forage utilization, animal performance, stand persistence, and seasonality differences. Evaluate the use of improved pastures, native rangeland and annual crops for use in managing for an integrated and sustainable forage-crop-livestock approach.

Project Name: **IMPROVEMENT OF FORAGE GERMLASM FOR CONSERVATION
& FORAGE-LIVESTOCK SYSTEMS IN THE NO. GREAT PLAINS**

Project # 5445-21000-006-00D; Mode Code 5445-05-10

Northern Plains Area - Northern Great Plains Research Laboratory - Natural Resource Management Research

Principal Investigator: John Berdahl

Northern Great Plains RL, Bldg. 2

Hwy 6 S

Mandan, ND 58554-0000

Voice: 701-663-3004; Fax: 701-667-3054; E-Mail:

BERDAHLJ@ars.usda.gov

OBJECTIVES: Develop forage germplasm with improved establishment capability, nutritive quality, drought resistance, and disease resistance for use in crop-forage- livestock systems in the Northern Great Plains. Develop methods to incorporate improved forages into management systems that will supply high quality forage over an extended grazing season, increase profitability, and protect the natural resource base.

APPROACH: Select among and within half-sib families of important cool-season grasses and dryland alfalfa for seedling vigor, nutritive quality, drought resistance, and disease resistance. Develop and test methods for incorporating improved grass and alfalfa germplasm into dryland crop-forage-livestock systems. Monitor the effects of temperature, soil water, and soil mineral levels on extent and rate of digestion and on fiber and mineral concentrations of improved forage germplasm throughout the grazing season. Evaluate effects of soil water and N on growth and development, nutritive quality, rooting depth, plant gas exchange, water relations, and C-13 carbon isotope discrimination on tetraploid Russian wildrye and other elite forage germplasm using a field rain shelter. Describe seedling morphology and crown placement for different forage species and cultivars. Continue development of effective screening techniques for resistance to plant pathogens causing major disease damage to forages, particularly pathogens causing root rot diseases.

Project Name: **DEVELOPMENT OF COTTON GERMLASM WITH IMPROVED
TOLERANCE TO ABIOTIC STRESSES**

Project # 6208-21000-010-00D; Mode Code 6208-05-15

Southern Plains Area - Cropping Systems Research Lab - Plant Stress and Germplasm Development Research

Principal Investigator: Melvin Oliver

Route 3 Box 215

Lubbock, TX 79401

Voice: 806-746-5353; Fax: 806-744-4402; E-Mail:

moliver@mail.csrl.ars.usda.gov

OBJECTIVES: To conduct fundamental and applied research to develop cotton germplasm, through traditional, novel molecular and biotechnological approaches, that can maintain productivity under stressful abiotic environments and the biotic stresses associated with them.

APPROACH: 1) To access procedures to improve the transformation of cotton for germplasm expansion and to reduce the varietal specificity of the current protocols; 2) to evaluate the role of glycine, betaine and other metabolites in osmoprotection and nitrogen status of cotton and biotechnologically assess alterations in such compounds; 3) to produce gene constructs to determine the efficacy of rehydrins in extending drought tolerance limits for cotton; 4) to alter the lipid composition of cotton root plasmamembranes to improve chilling tolerance and resistance to seedling diseases. IBC recertification 02-19-98 by Jeff Velten.

Project Name: **FORAGE GERMPLASM DEVELOPMENT FOR INCREASED SUSTAINABILITY OF AGRICULTURAL AND RANGELAND ECOSYSTEMS**

Project # 6216-11210-004-00D; Mode Code 6216-05-00

Southern Plains Area - Rangeland and Pasture Research

Principal Investigator: Chester Dewald

2000 18th St

Woodward, OK 73801-0000

Voice: 580-256-7449; Fax: 580-256-1322; E-Mail: cdewald@ag.gov

OBJECTIVES: Develop enhanced forage and grain producing eastern gamagrass and big and sand bluestem cultivars for improved pastures and to complement native rangeland. Develop Texas bluegrass lines and interspecific hybrids with Argentine and Kentucky bluegrass for improved mode of reproduction and quantity and quality of cool-season forage. Select, characterize, and map genes controlling apomixis in Eastern gamagrass and develop methods for their transfer to other grasses and crops.

APPROACH: The overall approach is to identify germplasm with desirable traits, to expand the limits of germplasm variation by wide hybridization utilizing interspecific and intergeneric introgression and genetic manipulation, to evaluate and select superior genotypes, and then release superior germplasm and improved cultivars. A broad-base germplasm collection of eastern gamagrass, big and sand bluestem, and Texas bluegrass are maintained at the Southern Plains Range Research Station at Woodward, OK. Facilities include a 35 x 40' breeding chamber, 5000 sq. feet of glass house space, a cytological-molecular laboratory equipped with light and fluorescent microscopes, karyotyping work station - densitometer imaging system and RFLP, RAPD-PCR accessories, sterile laminar flow hood, four growth chambers, a -80 C freezer, and ample acreage for field trials and nurseries. This research will involve basic agronomic, physiology, genetics, cytogenetics and molecular biology studies.

Project Name: **BIOCHEMICAL, PHYSICAL, MICROBIOLOGICAL MANAGEMENT FOR PREVENTION OF MYCOTOXINS IN PEANUTS**

Project # 6604-42000-005-00D; Mode Code 6604-05-00

South Atlantic Area - Peanut Research

Principal Investigator: Joe Dörner

1011 Forrester Drive, S.E.

Dawson, GA 31742-0000

Voice: 912- 995-7408; Fax: E-mail:

OBJECTIVES: Develop technology to prevent/control mycotoxin (especially aflatoxins) contamination of peanuts by further evaluation of the nature of natural resistance and the role of peanut phytoalexins in natural resistance; development/refinement of biological control agents such as non-aflatoxigenic strains of *A. flavus* and *A. parasiticus* as biocompetitive agents for preharvest control; development/evaluation of other management strategies; further refinement of postharvest removal/cleanup systems.

APPROACH: Previous studies in our environmental control plot facility using individual plant aflatoxin analysis have shown differences in resistance/ susceptibility between certain peanut germplasm. Additional studies to further identify drought resistant germplasm will be conducted. Collaborative studies with peanut breeders to utilize these resistant lines in the development of commercially acceptable aflatoxin resistant genotypes will be continued. Studies using

biocompetitive agents have shown a high degree of promise. Additional biocompetitive agent studies will be conducted to refine this technology for commercialization. An existing expert system (aflatoxin early warning system) for predicting the occurrence of preharvest aflatoxin contamination is in the final stages of refinement; another system is under development. Other appropriate preharvest/postharvest prevention strategies will be developed and tested as these become apparent.

Project Name: **ENVIRONMENTAL STRESSES, PHYSIOLOGICAL RESPONSES
AND PRODUCTIVITY**

Project # 6615-12210-001-00D; Mode Code 6615-20-00

South Atlantic Area - Crop Genetic and Environmental Research

Principal Investigator: Thomas Sinclair

1700 S.W. 23rd Dr

Gainesville, FL 32608-0000

Voice: 352-392-6180; Fax: 352-374-5896; E-Mail: aksch@gnv.ifas.ufl.edu

OBJECTIVES: To understand and thereby to provide means to modify the detrimental crop responses to environmental stresses, particularly water deficits.

APPROACH: Four approaches to researching environmental stresses will be pursued. (A) Investigate a drought avoidance trait in maize. (B) Explore opportunities to incorporate aerenchyma into the anatomy of maize roots. (C) Develop tolerance to water deficits in the symbiotic nitrogen fixation activity of soybean. (D) Facilitate the application of simple crop growth models by various users.

Project Name: **INCREASING THE COMPETITIVE POSITION OF US SOYBEANS
IN GLOBAL MARKETS THROUGH PLANT BREEDING**

Project # 6645-21220-005-00D; Mode Code 6645-35-00

South Atlantic Area - Soybean and Nitrogen Fixation Research

Principal Investigator: Paul Bishop

Gardner Hall, Room 4526

Box 7615, NCSU

Raleigh, NC 27695-7615

Voice: 919-515-3770; Fax:

OBJECTIVES: To develop diverse genetic resources exhibiting traits that enhance quality and productivity of soybean, and biocontrol strategies for resistance to fungal toxins and removal of excess N from soil applied animal wastes.

APPROACH: Improve soybean quality and productivity through development of genetically diverse germplasm exhibiting traits for altered seed composition, morphological traits, drought tolerance and soyfood characteristics. Characterize genes that govern nitrogenase and MO uptake systems in bacteria. Evaluate utility of soybeans in animal waste management systems. Characterize genes that govern toxin synthesis and transport in microorganisms. Raleigh, NC. Gardner Hall, Room 2417, BL-1, 07/01/96; and Room 4267, BL-1, 07/01/96. Scientists and technicians associated with project: R.G. Upchurch, P.E. Bishop, T. Loveless.

US DEPARTMENT OF AGRICULTURE

The following is a list of a few ongoing research projects with a component aimed at drought mitigation:

(with relevant CRIS project numbers)

Lubbock, Texas

1. Wind erosion processes, fugitive dust emissions, and mitigation strategies. (6208-11120-004-00D)

Long-term continuous monitoring of dust concentration and climatic parameters allow a correlation between ambient dust levels and drought for current land use patterns. Dust monitoring in different agricultural regions allows the determination of which management systems are most sensitive to drought conditions. Thus, such studies can be used to quantify the effects of drought and current agricultural practices on dust levels and a long term dust record could potentially provide a measure of how changing agricultural practices provide regional mitigation of drought induced dust.

2. Sustainable agricultural systems that reduce wind erosion and dust emissions.(6208-12000-006-00D)

The ARS strategy in drought mitigation relates to methods of relieving the effects of drought and not weather modification *per se*. The effects of drought often include wind-induced soil erosion which impacts plant production, profitability, and air quality. ARS develops economically and environmentally viable agricultural systems that conserve water and control wind erosion.

3. Strategies for irrigated and dryland crop production in semi-arid climates. (6208-13000-004-00D)

Semi-arid crop production occurs under either rainfed or a combination of rainfall supplemented by irrigation. Expert management is needed to maximize the efficiency of water use and the best technologies from physical and biological sciences must be employed. The project objectives are: 1) Develop quantitative information on energy and water transport in stressed crops, defining plant archetypes and management strategies that impact water-use efficiency; 2) Develop strategies for using current climate conditions and long range weather variability predictions as a management tool for the agricultural industry; 3) Develop strategies to improve the capture and use of rainfall by crops; 4) Devise new irrigation and dryland management strategies for existing germplasm and crops genetically modified for water and thermal stress tolerance; and 5) Using remote sensing and precision agriculture technologies, define management strategies to alleviate the impact of water deficits on crop production. A major contribution from this research project and others listed below is BIOTIC, a patented irrigation management device, that controls irrigation based on continuously measured canopy temperature, a location specific time factor and a species specific temperature threshold.

4. Improving plant performance in adverse environments. (6208-21000-008-00D)

The fundamental impact of drought, a combination of heat and water stress, on the ability of a crop to reach its potential yield capability and quality levels is directly correlated to the ability of the cells of plant tissues to protect themselves from damage or to quickly repair what damage occurs. This project is directly aimed at understanding how plant cells achieve these goals by the production and control of heat shock protein biosynthesis and the development of thermotolerance and the production and control of proteins that confer vegetative desiccation (the severest form of water stress) tolerance. The results from this research are being used to evaluate breeding and biotechnological strategies for drought tolerance in major US crops.

5. Cotton root systems: genetic diversity and response to environmental stress. (6208-21000-009-00D)

A key element in the ability of a crop plant to mitigate the effect of drought is the establishment and maintenance of an efficient root system that can extract available moisture from the surrounding soil.

This project is aimed at identifying cotton germplasm that has the capability of producing root systems that work effectively in soils that are deficient in water or can maximize the use of water when it becomes available such that the effect of drought on crop productivity is minimized. This project is also investigating the role that symbiotic fungi (mycorrhizae) play in channeling water and nutrients to cotton root systems in order to develop management strategies that would maximize the benefits of such an association under drought conditions.

7. Development of cotton germplasm with improved tolerance to abiotic stresses. (6208-21000-010-00D)

A major component of any strategy to improve the ability of a crop to mitigate the effects of drought is the use of a biotechnology. This project is aimed at using genes that have been identified as being associated with drought tolerance in other plant species or other organisms to improve the stress tolerance capabilities of cotton (in the long term other crops will be targeted). The project is presently aimed at using genes from a desiccation tolerant moss (a non-flowering plant that can tolerate the loss of all its internal free water) to improve the water stress resistance of cotton. The project is also concerned with developing better techniques for introducing genes into cotton and other crop plants.

Woodward, Oklahoma

Issues:

Drought is a most common characteristic of Southern Plains climate and new cultivars to reclaim marginal crop land in a permanent cover to control soil erosion requires availability of improved native or exotic grasses that will withstand precipitation shortfalls. Drought tolerant grasses released from Woodward since 1982, in cooperation with the NRCS, Texas Tech University, Texas A&M, are now planted on more than 3 million acres in the Southern Plains. There remains a continuing need for additional cultivars that have tolerance to drought and other factors that limit their use. CRIS Projects:

1) 6216-12110-001-00D: Forage germplasm development for increased sustainability of agricultural and rangeland ecosystems; 2) 6216-21630-005-00D: Rangeland and pasture ecosystem management in the Southern Plains.

Tucson, Arizona

1. Radar-Rainfall Related Research for “Drought Mitigation”

A critical factor for both planning for drought mitigation and assessing the impacts of drought is having accurate knowledge of rainfall in space and time. However, it is not economically feasible to provide raingage networks at sufficient spatial densities over the vast public and private land areas in the West. Installation of ground-based radars throughout the West and Southwest offer a potential tool to provide rainfall characteristics over large land areas. Unfortunately, radar-based rainfall estimates have not been adequately researched or verified in many of these environments. Detailed raingages observations from ARS Walnut Gulch Experimental Watershed (85 raingages in the 148 sq. km) will be used to quantify the capabilities of “standard” radar-rainfall reflectivity relationships used by the National Weather Service in this region and potentially to develop improved relationships.

2. Linkage of ENSO and Other Large-scale Forcing to Precipitation

Droughts in the southern and southwest portions of the United States are known to be highly correlated to La Niño episodes. Research is being carried out to improve the forecast capability of daily precipitation by incorporation of the El Niño/La Niño-Southern Oscillation (ENSO) signal using

the Southern Oscillation Index (SOI) into daily precipitation models. Using historical rainfall data the method can determine if daily rainfall is significantly influenced by ENSO/LNSO, which months are significantly influenced, and provide a early warning forecast from the SOI when daily and seasonal precipitation may be reduced (indication of a drought beginning) or when precipitation may be increased (ending of a drought). CRIS projects: 5342-13610-005-00D: Hydrologic processes, scale, water resources, and potential global change impacts in semi-arid areas.

Florence, South Carolina

Hydrologic Processes, Scale, Water Resources, and Potential Global Change Impacts in Semiarid Areas

Problem: In humid and sub-humid areas, crops can suffer from both water excess and drought, often within the same growing season. Annual rainfall usually exceeds evaporation, but rainfall is poorly distributed within the growing season. The sandy soils of the SE Coastal Plain store relatively little water and are quite variable even in small fields. Consequently, crops in some areas of most fields suffer from drought multiple times in most years and even on the best soils, may suffer drought in one year of two. For agriculture to be consistently profitable, improved methods of water management must be developed. These methods must protect the environment, conserve the water supply, and for maximum efficiency be adaptable to variable-rate technologies.

- * Developing site-specific center pivot irrigation systems for water, nutrient, and pesticide management.
- * Developing irrigation scheduling decision aid for personal computer that accommodates rainfall probability, leaving storage capacity for rainfall after irrigation.
- * Developing subsurface drip irrigation systems and water and nutrient management techniques for agronomic and horticultural crops of the region.
- * Developing color plastic mulches to combine irrigation and water conservation measures with photobiological management of plant growth.
- * Investigating season water use patterns and their effect on transient water stress using both field measurements and computer simulation models.

CRIS projects: 6657-13000-005-00D: Managing southeastern coastal plains natural resources for profitable agriculture and environmental quality.

El Reno, Oklahoma

Issues- Most of the agricultural enterprise in the Southern Great Plains (SGP) are based on dryland farming. Grazing systems and livestock production are integrated with crop production systems to provide diversity and are for the most part dependent upon non-irrigated acres as a source of feed. Both cropping and grazing systems are vulnerable to droughts that disrupt efforts to achieve a stable, sustainable, diverse and economically viable agricultural production enterprise. Economic losses due to droughts are not limited to the farmers and ranchers, but also impact local and regional economics and consumers world wide through volatile prices, inconsistent farm product quality and irregular supplies. Research is underway to develop technology and methodologies for rapid assessment of regional soil moisture reserves, to incorporate new long-lead climate outlook projects into risk based decision making processes, and to find alternative forage production systems that are flexible and adaptable to drought situations. CRIS projects: 6218-11130-001-00D; 6218-13000-008-00D; 6218-21000-004-00D.

Las Cruces, New Mexico

Issues:

1. What are the persisting effects of severe drought in this environment?

We do this through maintenance of long term (since 1915) studies on desert vegetation dynamics that can be tracked during drought years. We have learned that effects are certainly site specific, but they are also related to the state that the site is in. If the site is in a transitional state, then drought can be a factor that causes that state to change, and change rapidly. We have observed huge changes in a few years.

2. How can we distinguish the effects of drought from the effects of other typical stressors (the main ones are grazing and fire) to desert rangelands?

We have done this through manipulative studies where we control certain stressors, including drought (by using rain out shelters) and observing cascading effects on vegetation, soil and animal populations. Obviously, we have learned that drought overwhelms all other stressors, and its effects are seriously magnified if other stressors occur in common. This is especially true of overgrazing.

3. What indicators can we use to monitor the conditions of these lands so we can adjust our management in order to mitigate the effects of stress, especially drought?

This is one of our main research objectives, and is a key issue. It is not directly a drought mitigation question, but the development of tools for managing lands that experience severe drought in at least 1 year out of 5. We do this by trying to identify properties of systems that reflect key processes and then identify indicators of those properties which can be measured in some reliable fashion. Thus, soil surface organic matter is a property of nutrient cycling and a slake test seems to be an indicator of SOM.

4. What technologies can be used that are low input, inexpensive, ecologically-based, and effective which will re-mediate lands degraded by the effects of drought?

We have learned that our agronomic tools, like use of a rangeland drill or broad scale chemical programs are extremely inefficient in arid environments. We devote an increasing amount of our research to new approaches. These are VERY small scale, very passive, but very cheap.

APPENDIX D. Summary of Recommended Federal Actions from Earlier Drought Episode Reports

Table 13. Recommended changes in NRCS programs and policies to improve agency ability to reduce drought to farmers, ranchers, and rural communities.

Irrigated Farms

Irrigation Management Practices

- Promote irrigation scheduling and system evaluation
- Increase cost-sharing for sprinkler and/or surge systems
- Promote supplemental irrigation
- Increase irrigation efficiencies
- Increase use of drip/trickle systems on vegetables and orchards
- Provide incentives and cost-share programs for irrigation system modifications

Water/Crop/Land Management Practices

- Provide incentive programs for ground water recharge
- Develop farm management plans for below-normal, normal, and above-normal water supplies
- Promote recycling of municipal and industrial water
- Inventory water supply options (e.g., surface impoundment sites, ground water reserves, streams) available for a variety of user needs
- Promote selection of drought resistant, low water use crops/varieties

Human and Financial Resources

- Devote more human resources to total resource management planning

Legal/Institutional

- Increase interagency cooperation on irrigation water management
- Implement total resource management system planning within SCS
- Relax rules on irrigation-induced wetlands during drought conditions
- Encourage partnerships between rural and urban communities through incentive programs

Education

- Improve educational and technical assistance programs on water management and conservation
- Improve education on irrigation techniques, including equipment
- Provide additional technical assistance to farmers on appropriate drought mitigation actions
- Provide better educational programs on the effect of improper irrigation practices
- Increase field demonstrations on irrigation water management
- Provide more training on efficient use of water
- Provide greater information on the effects of improper irrigation practices

Data/Information Products/Delivery Systems

- Provide better information on best management practices during drought
- Expand SNOTEL data collection network, improve forecasts
- Develop and implement surface water supply indexes
- Implement process simulation hydrologic models
- Improve monitoring and management of ground water withdrawals
- Provide additional information about soil water potential requirements
- Develop more specific water use data needed for crops
- Improve surface and ground water supply monitoring systems
- Promote more extensive soil moisture monitoring
- Upgrade information delivery systems to farms on available water supplies
- Improve dissemination of water supply forecasts
- Develop more efficient delivery systems

Table 13. Recommended changes in NRCS programs and policies to improve agency ability to reduce drought to farmers, ranchers, and rural communities. (Continued)

Nonirrigated farms

Water/Crop/Land Management

- Increase emphasis on water quality
- Increase technical and financial assistance to promote snow management practices (e.g., windbreaks, grass strips, stripcropping)
- Develop more farm ponds
- Assist in selecting drought resistant crops/varieties
- Promote conservation practices (e.g., conservation tillage, residue management, and drought resistant crop varieties)
- Increase emphasis on strip-cropping, contour farming, and wind barriers
- Adopt more crop rotations to better use available moisture
- Develop early maturing crops
- Promote flexible cropping systems

Legal/Institutional

- Establish the use of PL-566 cost-sharing for water conservation in humid areas as a higher priority

Education

- Continue emphasis on CRM educational programs
- Provide training for farm-level drought plan development
- Increase field demonstrations of residue management techniques

Data/Information Products/Delivery Systems

- Improve soil moisture monitoring programs
- Expand SNOTEL system, improve water supply forecasts
- Develop and implement surface water supply indexes
- Develop better drought indicators and forecasts
- Improve dissemination of water supply forecasts

(NRCS2, J.Frost, 5/99)

Table 13. Recommended changes in NRCS programs and policies to improve agency ability to reduce drought to farmers, ranchers, and rural communities. (Continued)

Ranches with Irrigation

Irrigation Management

- Integrate irrigation practices with other water needs (e.g., livestock)
- Develop irrigation water management plans
- Water Management
- Develop dependable livestock water systems through pipelines and rural water systems

Rangeland Management

- Inventory and manage forage produced on grazing lands

Education

- Develop programs to train persons on drought preparedness techniques
- Develop programs to encourage the maintenance of adequate feed reserves
- Develop incentives to encourage proper stocking rates

Rural Communities

Water Management

- Provide technical assistance through RC&D for water supply systems and monitoring
- Modify PL-566 to make rural water supplies eligible for cost-sharing
- Provide technical and financial assistance to rural communities for water supply development
- Emphasize total watershed protection to increase surface and subsurface storage
- Expand rural water systems to serve both towns and farms
- Emphasize watershed planning

Legal/Institutional

- Assist rural communities in the development of a drought plan

Education

- Develop programs on drought preparedness
- Promote water conservation
- Encourage use of drought-tolerant plants in landscapes
- Encourage xeriscaping
- Develop programs to improve lawn and shrub irrigation efficiencies
- Develop lawn watering programs

Data/Information Products/Delivery Systems

- Improve drought indicators

Table 14. Recommendations for NRCS on helping farmers and ranchers respond to increasing demands for water to preserve environmental quality during droughts.

Irrigation Management

- Improve marketing of drip irrigation systems
- Promote irrigation efficiency
- Provide greater technical assistance for water storage for use during irrigation season or for release to augment stream flow
- Promote ground water recharge
- Promote drip irrigation
- Encourage use of sprinkler systems

Water/Land/Crop Management

- Promote crop rotations that enhance infiltration
- Develop ditch storage system
- Increase technical assistance to landowners to assist them in better land management
- Develop water storage structures on streams
- Better management of systems and structures
- Use water from deep aquifers rather than surface water
- Promote adoption of total resource management system plans
- Maintain and establish stream buffers for all land uses
- Develop detention measures in projects that augment stream flows
- Provide assistance to water users to install water measurement devices to ensure diversion of allocated amounts
- Build more structures with gated outlets from bottoms of ponds
- Plan and apply RMS's on watersheds that will have the greatest impacts on water quality and quantity
- Emphasize on-site practices (e.g., residue management, irrigation water management, proper grazing techniques, terraces) that have a direct/indirect benefit in enhancing in-stream flows
- Promote sound land use and conservation measures
- Encourage use of drought-tolerant crops

Legal/Institutional

- Work with state and local government on drought response plans
- Assist in changing water laws to allow farmers to “market” excess water (i.e., transfer of water between users)
- Promote NRCS as leader in water conservation techniques
- Change attitude within NRCS of addressing one resource concern (e.g., soil erosion) to one of addressing the entire ecosystem

Education and Training

- Disseminate information that promotes shifts from more to less water-dependent cropping systems
- Provide education and technical assistance on crop irrigation requirements

Environmental Quality

- Promote water quality enhancement and protection
- Balance efficient use of agricultural water with environmental needs
- Promote alternate crops that are in harmony with local environment, reducing the need for irrigation

Data/Information Products/Delivery Systems

- Develop soil moisture monitoring programs
- Assist USGS with low flow monitoring
- Develop and use process simulation models for stream flow forecasting

Table 15. Recommendations for NRCS on improving technical standards and assistance activities to foster use of drought mitigation practices by landowners and rural communities.

Water/Crop/Land Management

- Target funds and personnel to assist with drought mitigation practices
- Create more flexibility for USDA commodity programs
- Provide cost-share assistance for residue management and mulching practices during drought
- Alter NRCS priorities to allow more time for drought mitigation activities
- Improve policies on pond construction, using a team approach for site assessment, etc.
- Make water quantity issues a higher priority within NRCS
- Improve water conservation research and partnerships with research agencies
- Develop a coalition of agencies to cooperatively develop technical methods and approaches for irrigators and farm managers

Education and Training

- Provide better information on irrigation management systems
- Make working with individual landowners on drought mitigation practices a priority; techniques are known, education is the key
- Handle drought mitigation practices through the Field Office Technical Guide
- Develop irrigation handbook for use by personnel and consultants
- Communicate, coordinate, and be involved in identifying and solving problems related to soil, air, plant, and animal resources
- Provide more technical assistance on resource planning rather than administering farm bills
- Prepare fact sheets of recommended drought mitigation practices for farmer and rural communities, including emergency crop and land management responses
- Provide better training of landowners and rural communities on drought mitigation measures
- Provide information on the economic benefits of drought mitigation practices

Data./Informational Products/Delivery Systems

- Expand collection of data on climatic and soil moisture conditions
- Use remotely sensed data to assist with drought assessment
- Improve soil moisture monitoring

- Improve program delivery
- Improve methods of disseminating research findings to field personnel in a user-friendly format

Table 00.

EPA STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

(epaag2, G.Hudiburgh, 5/14/99)

In 1997, the US Environmental Protection Agency (EPA) issued a statement of principles on efficient water use. The statement follows.

In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes careful, efficient use of water, is essential in order to achieve these objectives.

Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. As we face increasing risks to ecosystems and their biological integrity, the inextricable link between water quality and water quantity becomes more important. Water efficiency is one way of addressing water quality and quantity goals. The efficient use of water can also prevent pollution by reducing wastewater flows, recycling industrial process water, reclaiming wastewater, and using less energy.

The U.S. Environmental Protection Agency's (EPA) Office of Water strongly encourages all sectors, including municipal, industrial, and agricultural, to achieve efficient water use.

EPA recognizes that regional, state, and local differences exist regarding water quality, quantity, and usage. Differences in climate, geography, state institutions, and laws favor a prudent approach in which water efficiency programs are tailored for specific locales.

To promote efficient water use, EPA's primary role is to provide technical assistance and information concentrating on 1) improved management practices, 2) better science, 3) effective planning and coordination, 4) market incentives, and 5) public education.

Agricultural water suppliers and users need to have an integrated water management plan that incorporates a drought mitigation plan and conservation programs. They also need an effective State/regional drought mitigation plan and supporting programs which are coordinated, in turn, with a coordinated Federal policy and programs.

Sec.4(b)(8) "include a recommendation on whether all Federal drought preparation and response programs should be consolidated under one existing Federal agency and, if so, identify such agency;"

Dan R. Upchurch (ARS, Lubbock, Texas)

I agree with the recommendation made by Merle A. Venezio that "all Federal drought preparation and response programs should be consolidated and assigned to the Secretary of Agriculture, given appropriate staff and funding. USDA as the agency-in-charge, given its variety of programs and the fact that the first effects of drought often appear in the agricultural sector and in firefighting efforts."